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TREATMENT OUTCOMES AND RETENTION IN MEDICAID AND NON-MEDICAID ORTHODONTIC PATIENTS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

by

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Abstract

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Medicaid orthodontic patients have been shown to miss more appointments and break more appliances than self-pay patients, indicating a greater tendency toward non-compliance. Lack of compliance during the post-treatment phase can be detrimental to retention. The purpose of this study was to determine whether there is a difference in PAR score changes between Medicaid and non-Medicaid patients during and after orthodontic treatment. PAR scores were determined using study models of 43 Medicaid and 39 non-Medicaid patients before and at the end of active treatment, and 24 Medicaid and 42 non-Medicaid patients at the end of treatment and at an average of 13 months post-treatment. PAR scores generally reduce during treatment and will increase if relapse occurs. Rates of PAR score change during and after treatment were compared between Medicaid and non-Medicaid patients using the Mann-Whitney

U-test. The mean initial PAR score was greater in the Medicaid group (31.95 versus 23.28; p=0.003) while there was no significant difference found between the two groups for the end of treatment PAR scores (3.22 versus 2.93; p=0.451). The rates of PAR score improvement during treatment (14.07/year versus 12.14/year; p=0.203) and worsening after the removal of orthodontic appliances (2.04/year versus 2.91/year; p=0.872) were found not to differ between the two groups. It was found that the rate of PAR score improvement during treatment did not differ between Medicaid and non-Medicaid patients. During the post-treatment period, the rate of PAR score worsening was also found not to differ.

Introduction

1. *Medicaid overview*

Title XIX of the Social Security Act of 1965 established Medicaid as a form of publicly funded health insurance for the needy. Medicaid was designed to allow participants to use the same medical resources utilized by the general public without prohibitive cost. Funding for this program is currently provided by both the federal and state governments. Although state governments establish the eligibility requirements and services provided, the federal government maintains a minimum set of standards.

The federal government's share of Medicaid expenses is calculated state-by-state and is based upon the state's average per capita income level. This proportion, known as the Federal Medical Assistance Percentage (FMAP), is determined annually and is limited at 83 percent, with a minimum contribution of 50 percent. In 2004, the FMAP varied state-to-state from 50 percent to 77 percent, and averaged 60 percent overall.[1]

Medicaid is the largest health insurance provider in the United States.[2] In 2000, 12.3 percent of the population was enrolled in Medicaid, demonstrating the significance of Medicaid as a comprehensive health care provider. The number of Medicaid enrollees in 2002 was estimated to be 39.9 million, with children constituting 46 percent.[1]

2. *Orthodontic component of Medicaid*

Although participation in the Medicaid program is at the state's discretion, certain services are mandatory once a state participates in the program. One of these services is the Early Periodic Screening, Diagnostic and Treatment (EPSDT) component for all children under

the age of 21.[3] This includes the orthodontic treatment of handicapping malocclusions, which implies a severe structural or functional deviation from the optimal state.[4]

3. Various indices available for determining orthodontic Medicaid eligibility

There has been some difficulty in determining what is considered a "handicapping malocclusion" and thus eligibility criteria for orthodontic treatment under the Medicaid program. The American Association of Orthodontists officially adopted the Salzmann index[5] in 1969 as a means of determining orthodontic treatment need, but then rescinded its endorsement in 1985, as they were opposed to the use of any index to identify treatment need.[6] Regardless, states have relied upon several occlusal indices to determine eligibility for orthodontic coverage, including the Salzmann index, the Handicapping Labio-Lingual Deviation (HLD) index,[7] the Index of Orthodontic Treatment Need (IOTN),[8] the Grainger Orthodontic Treatment Priority index,[9] and the Peer Assessment Rating (PAR) index.[10, 11] The majority of states use the Salzmann or the HLD indices to determine eligibility.[12] The state of Virginia uses the Salzmann index.

4. Need for orthodontics and disparity between treatment needed and treatment delivered

A large proportion of children in the United States do not receive the dental treatment they require. Fisher et al.[13] found that 42 percent of Medicaid insured children were in need of some immediate form of dental treatment. This trend in dentistry is echoed in orthodontics. Specifically, in the United States the prevalence of malocclusion severe enough to affect social acceptability or function is estimated at about 15 percent, while an estimated 57 to 59 percent of the population has some orthodontic need, based on the Index of Orthodontic Treatment Need.[14] In contrast, Medicaid-eligible children do not appear to have readily available access to orthodontic care, as reported in the states of Washington and North Carolina. In Washington

state, only 0.45% of Medicaid-eligible children received any orthodontic intervention.[15] Similarly, in North Carolina, 0.5% of Medicaid-eligible children received orthodontic care from 2002 to 2003.[16]

5. *Reasons for the discrepancy between treatment needed and treatment provided*

This gross discrepancy between treatment needed and actual services performed has many causes, including a reduction in providers, changes in funding and facilities, an increasing number of people in need, and changing cultural values.[17, 18] In Washington State, 25 percent of dentists care for nearly 90 percent of the children that are seen under Medicaid.[19] Although well documented in the states of Washington and North Carolina, there is no reason to believe that the other states do not exhibit similar disparities due to the similarity of Medicaid programs nationwide.

A recent survey of North Carolina orthodontists found that approximately 75 percent do not accept Medicaid patients. Low fee reimbursement was found to be the most commonly cited problem with Medicaid by North Carolina orthodontists. Patient management issues were cited more commonly by orthodontists that did not currently accept Medicaid patients than by those that were currently treating Medicaid patients.[16] A recent survey of Louisiana dentists found that broken appointments were the most frequently reported problem with the Medicaid program in that state, followed by low fees and patient compliance.[20]

At the Virginia Commonwealth University Department of Orthodontics, it was found that during a particular 12-month period, Medicaid patients had more appointment failures than non-Medicaid patients. This retrospective study found that Medicaid patients failed 15.4% of their scheduled appointments while non-Medicaid patients failed 8.3% of their appointments.[21]

6. Indices to assess malocclusion

Several indices exist for the purpose of objectively assessing the severity of a malocclusion. Many of these indices are often inappropriately used as a means of measuring treatment outcomes.[22] The Index of Orthodontic Treatment Need (IOTN) involves recognition of features that may impair the health and function of the dentition, including: overjet, reverse overjet, overbite, open bite, crossbite, displaced teeth, impeded eruption, clefting of the dentoalveolar process, class II and class III buccal occlusions, and hypodontia.[23] An index developed by the American Board of Orthodontics (ABO), referred to as the Objective Grading System (OGS), was established to evaluate the final dental casts and radiographs of ABO candidates. The OGS evaluates alignment, marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, interproximal contacts, and root angulation.[24]

Unlike the American Board of Orthodontics' Objective Grading System (ABO OGS), the Peer Assessment Rating (PAR) index does not require a panoramic radiograph in its evaluation. Also, unlike the IOTN, the PAR index has been validated as a means of ascribing a numerical value to a malocclusion by analysis of a set of plaster models. The PAR index ascribes a numerical value to maxillary and mandibular alignment, buccal occlusion, overbite, overjet, and centerlines. Lower PAR index values are closer to ideal occlusion and higher scores indicate a greater deviation.[10] The PAR index was specifically designed to examine treatment standards and was tested for reliability and validity by an experienced group of orthodontists. Given that it has been validated for the specific task of evaluating treatment outcomes and that the only equipment needed is a set of dental casts, the PAR index is an excellent instrument for assessing orthodontic improvement.

7. Tooth movement is linear

Several studies have shown that tooth movement is, to some extent, linear. By analyzing the data accumulated through an exhaustive search of published studies, Quinn and Yoshikawa[25] concluded that the rate of tooth movement is most likely linearly related to the magnitude of applied stress, up to a point, beyond which there is no measurable increase. Melsen et al.[26] used finite element analyses paired with material data gathered by microcomputed tomography to model orthodontic tooth movement with varying magnitudes of force application. They found that with very light applied forces (less than 15 grams), the first mandibular molar experienced relatively large amounts of displacement with increasing force levels. With larger force levels, a linear relationship developed between the applied force and the immediate displacement of the mandibular molar. Reitan[27] found that during orthodontic movement, an initial undermining resorption period was followed by a generally linear secondary period of tooth movement. Pilon et al.[28] demonstrated that in beagle dogs, tooth movement went through an initial phase of PDL compression (phase 1), a lag phase during which hyalinization of the PDL was most likely occurring (phase 2), an acceleration phase (phase 3), and finally the period during which tooth movement was generally linear (phase 4). Iwasaki[29] showed that with very light forces in human subjects, a nearly linear mode of tooth movement was observed over time while canine retraction was achieved. As several studies have demonstrated that tooth movement has linear components, we assume that tooth movement during orthodontic treatment and retention is somewhat linear. Based on this assumption, the PAR score change during orthodontic treatment is evaluated in this study as a linear entity.

8. Method for measuring improvement of PAR index

Several methods have been described for assessing the degree of improvement of a case using the PAR index. One method involves simply subtracting the final PAR score from the initial PAR score, another method employs a percentage reduction of the initial PAR score, and a final method places pre-determined point reductions as limits for degrees of improvement.[11] One of the limitations of these methods for determining improvement of a case is that there is no inherent normalization for case difficulty to facilitate comparison between cases. If tooth movement is assumed to be linear, the comparison of rates of improvement in PAR scores may allow for more accurate evaluations of cases that have varying severities of malocclusion.

9. Relapse

The tendency for orthodontic relapse is a significant concern for clinicians. Certain orthodontic therapies are known to be less stable than others and patient compliance is of utmost importance in the maintenance of orthodontic treatment.[30] Reitan[31] found that up to 232 days after orthodontic rotation of teeth, some gingival fibers remain stretched and tend to cause relapse. Because of the lack of permanent reorganization of the gingival fibers and the absence of fixed orthodontic appliances during the retention period, patient compliance with retainers is important to maintain orthodontic corrections. Medicaid patients have presented a greater compliance challenge than non-Medicaid patients.[21] Since many retention protocols rely heavily on patients' compliance with wearing some form of removable retainer, it seems plausible that relapse would be more severe in Medicaid patients. One way to assess this relapse tendency is to determine the rate of PAR score increase (worsening) during the post-treatment phase.

10. PAR score changes during treatment

With increased appointment failures, it might be anticipated that Medicaid patients would experience a slower rate of orthodontic improvement during treatment. However, no published studies have investigated the rate of orthodontic improvement of Medicaid patients relative to non-Medicaid patients.

11. Purpose

The purpose of this study was to examine differences between the rates of orthodontic improvement of Medicaid and non-Medicaid patients.

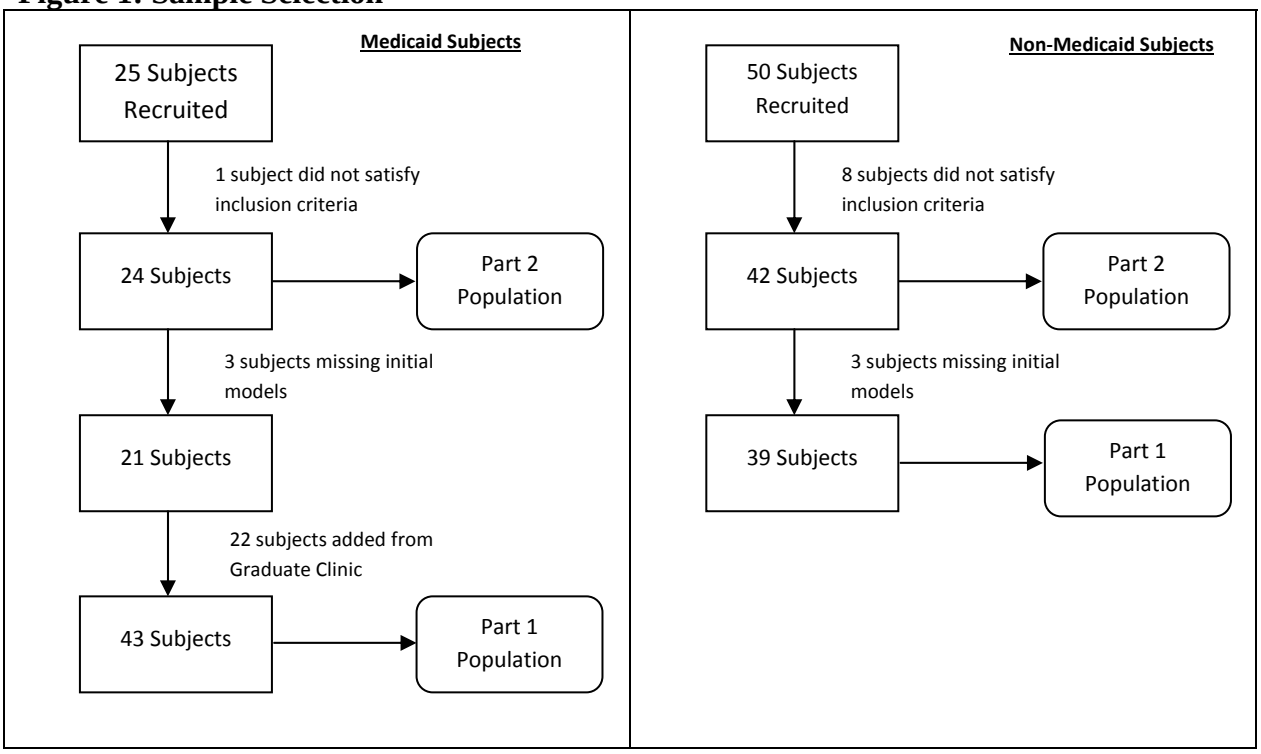
12. Aims

The specific aims of this study were: first, to determine whether there was a difference between PAR score improvement rates during active orthodontic treatment for a Medicaid and non-Medicaid population at the Virginia Commonwealth University Department of Orthodontics; second, to analyze the rate of relapse of Medicaid and non-Medicaid patients by determining the rate of PAR score worsening during the post-treatment period. The null hypothesis of this study was that Medicaid patients would have rates of PAR score improvement and worsening that are equal to those of non-Medicaid patients.

Materials and Methods

The Institutional Review Board granted permission for this study. The patients were treated by orthodontic residents under the supervision of full-time and part-time orthodontic faculty at the Virginia Commonwealth University Department of Orthodontics. Patients were recruited as they presented for their retention check appointments during a ten month period from January 2007 to October 2007. Dental impressions were taken at their respective retention check appointments and their records were subsequently reviewed. The inclusion criteria were: 1) patients treated non-surgically with full fixed orthodontic appliances; 2) patients under 18 years of age at the start of orthodontic treatment; 3) patients without clefting of the dentoalveolar complex; and 4) patients with complete records.

Figure 1: Sample Selection



For clarity, the study was divided into two sections: Part 1 of the study examined the difference in rate of PAR score improvement between Medicaid and non-Medicaid patients over the treatment period, while Part 2 of the study examined the difference in PAR score changes during the post-treatment phase. During the recruitment period, 25 Medicaid and 50 non-Medicaid patients were enrolled in the study.

Sample Selection

As illustrated in Figure 1, the initial pool of patients was recruited directly from the clinic by convenience sampling (25 Medicaid and 50 non-Medicaid patients). One Medicaid patient and eight non-Medicaid patients did not satisfy the inclusion criteria for the study, leaving 24 Medicaid and 42 non-Medicaid patients for the study. This group of patients had both final and retention models and was thus the population for Part 2 of the study.

The population for Part 2 was then retrospectively investigated for the availability of records and it was found that three patients in each group were missing initial models, making them ineligible for an analysis of PAR score improvement. The remaining 21 Medicaid and 39 non-Medicaid patients were included in Part 1 of the study (analysis of PAR score improvement during treatment). In order to increase the significance level of Part 1 of the study, an additional 22 Medicaid patients were randomly recruited from a list of patients that had completed treatment between 2004 and 2007, that had attended at least one subsequent retention appointment, and that otherwise satisfied the inclusion criteria. Therefore, 43 Medicaid and 39 non-Medicaid patients were evaluated for Part 1 of the study.

The protocol for Part 1 consisted of measuring PAR scores of pre- and post-treatment sets of models for each subject (43 Medicaid and 39 non-Medicaid). A method of comparing cases by how quickly the PAR score changed from one time period to another (rate of PAR score improvement) was utilized to remove the inherent comparative flaw that exists when examining cases of varying severity. To measure the rate of improvement of a case, the final PAR score was subtracted from the initial PAR score, and this value was then divided by the time the patient was in active treatment (in days). This daily rate of PAR score improvement value was multiplied by 365 to attain a yearly rate for each patient. This method assumes a linear change in PAR score and the linearity of tooth movement during orthodontic treatment.

The protocol for Part 2 consisted of measuring the PAR scores of each post-treatment and retention phase set of models for each subject (24 Medicaid and 42 non-Medicaid). The rate of PAR score relapse was calculated using the method described above: the final PAR score was subtracted from the retention PAR score, and was then divided by the time that the patient was out of active orthodontic therapy.

Ten pre-treatment models were randomly selected and PAR score measurements were repeated two weeks following the initial evaluation to assess intraexaminer reliability.

Statistical Analysis

All statistical analyses were performed using the SPSS computer software (SPSS, Chicago, IL). A Spearman correlation test was used to evaluate intraexaminer reliability. Statistical analyses were performed using the Mann-Whitney U-test. The dependent variables studied were the starting PAR score, the end of treatment PAR score, the rate of PAR score

improvement during treatment, and the rate of PAR score worsening after treatment. A significance level of 0.05 was utilized for all analyses.

Results

Patients were recruited by means of convenience sampling at the Virginia Commonwealth University Department of Orthodontics clinic. Patients were asked to participate in the study upon attending retention check appointments. No patients declined participation. Part 1 of the study included 46 Medicaid patients and 39 non-Medicaid patients, while Part 2 included 24 Medicaid patients and 42 non-Medicaid patients.

Patient demographics can be found in Table 1. Subjects were categorized based on the presence of an anterior open bite, whether they had teeth extracted for orthodontic purposes, gender, and starting Angle classification. Relatively few patients presented with anterior open bites. The majority of patients began with Angle Class I dentitions, while fewer patients presented with Class II dentitions. No Medicaid patients in the sample population presented with Class III dentitions, in contrast to two patients in the non-Medicaid group.

Table 1: Demographic Characteristics of Patients

	Anterior Open Bites	Extraction Cases	Males	Females	Class I	Class II	Class III
Medicaid							
Part 1 (n=43)	3 (7%)	16 (37%)	21 (49%)	22 (51%)	34 (79%)	9 (21%)	0
Part 2 (n=24)	0	8 (33%)	14 (58%)	10 (42%)	20 (83%)	4 (17%)	0
Non-Medicaid							
Part 1 (n=39)	1 (3%)	8 (21%)	15 (38%)	24 (62%)	28 (72%)	9 (23%)	2 (5%)
Part 2 (n=42)	1 (2%)	8 (19%)	16 (38%)	26 (62%)	31 (74%)	9 (21%)	2 (5%)

The Spearman correlation coefficient analyzing the repeated PAR score measurements for ten sets of models was 0.994 ($p<0.01$) indicating a high level of intraexaminer reliability.

The mean starting PAR score was significantly greater in the Medicaid group (31.95 versus 23.28; $p=0.003$). There was no statistically significant difference found between the end

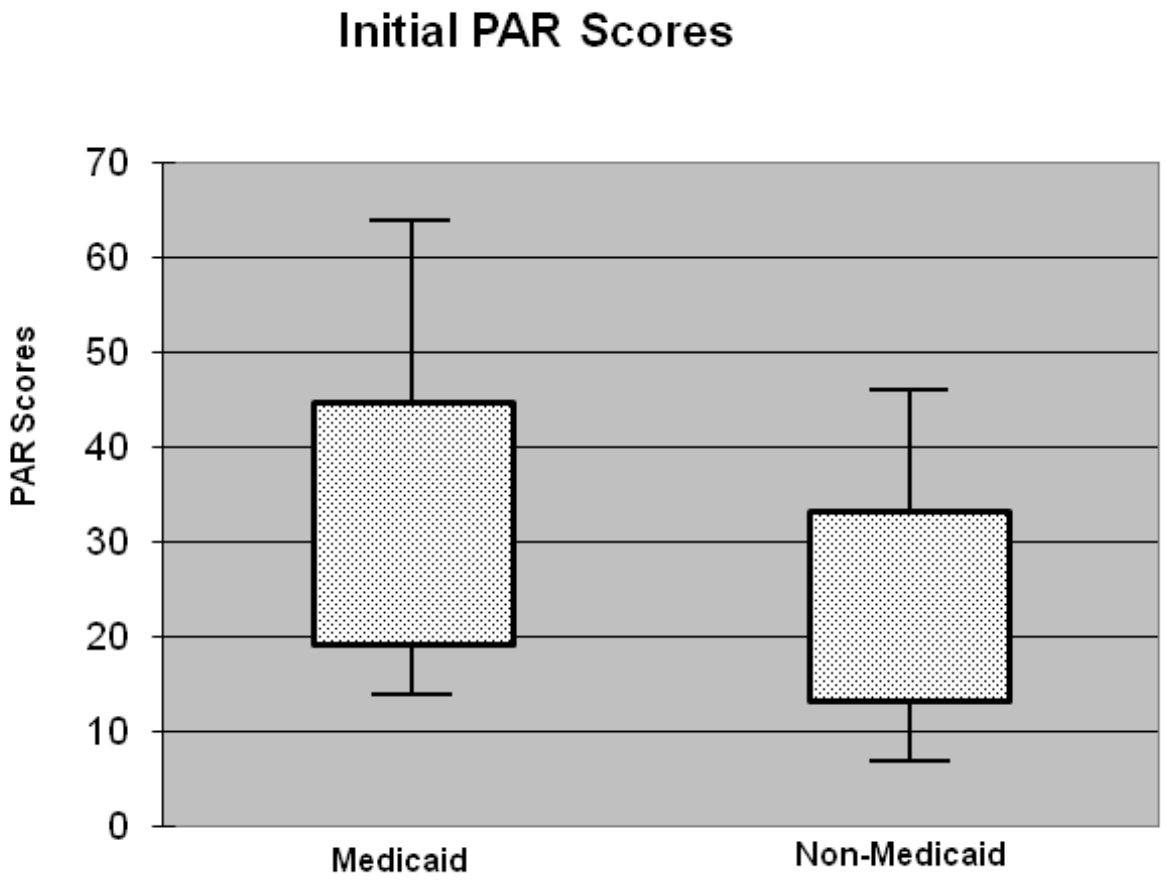
of treatment PAR scores for the two groups of patients (3.22 versus 2.93; p=0.451). The annual rate of PAR score improvement during treatment (14.07/year versus 12.14/year; p=0.203) and worsening after the removal of orthodontic appliances (2.04/year versus 2.91/year; p=0.872) were found to have means that did not differ statistically between the two groups.

Table 2: Summary of PAR Score Evaluations

	Initial PAR Score	Final PAR Score	Annual PAR Improvement Rate	Annual PAR Worsening Rate
Medicaid	31.95 (12.8)*	2.93 (3.5)	12.14 (6.6)	2.04 (5.0)
Non-Medicaid	23.28 (10.1)*	3.22 (3.5)	14.07 (6.8)	2.91 (8.0)

*p<0.05

Figure 2: Initial PAR Scores



Discussion

Previous studies have found that Medicaid patients may present a greater compliance challenge than non-Medicaid patients during orthodontic treatment.[15] This study was undertaken to determine whether there were actual differences between the orthodontic improvement of Medicaid and non-Medicaid patients in light of the greater number of appointment failures and the perceived compliance issues found in previous studies.[21] Two groups of patients were analyzed by evaluating the rate of PAR score improvement over the treatment period as well as the rate of worsening after complete removal of orthodontic appliances. It was found that the Medicaid patients began with malocclusions that were significantly worse (as determined by the PAR index) than the non-Medicaid patients. However, all patients finished at comparable levels. The difference in initial PAR score can be attributed to the requirement that the Medicaid patients have a minimum severity of malocclusion in order to be treated. Active orthodontic treatment is typically deemed complete once the following criteria are met: the patient's overjet and overbite are within an ideal range, rotations and crossbites are eliminated, good posterior interdigitation is achieved, midlines are coincident, and the orthodontist’s clinical judgment is satisfied. Since a patient that has completed orthodontic therapy will have satisfied these criteria, it is not surprising that the final PAR score of patients in both groups did not differ statistically.

The annual rate of PAR score improvement was found not to differ between the two groups of patients. This finding implies that although Medicaid patients tend to miss more appointments and are perceived as less compliant than non-Medicaid patients, the malocclusions of both groups improve at the same rate. One possible explanation for this similarity may be that

the period between adjustments is generally too short. As a result, non-Medicaid patients may be seen more frequently than is necessary and broken appointments do not automatically hinder the rate of PAR score improvement in Medicaid patients. Another explanation may be that the orthodontist is more proactive with treatment during an average Medicaid patient's appointment to compensate for missed appointments. The annual rate of PAR score worsening during the retention phase was also found not to differ significantly between the two groups. This similarity could be explained by equal levels of compliance between the Medicaid and non-Medicaid groups with retention protocols. Perhaps all patients have similar levels of compliance during the retention phase. Another plausible explanation may be that due to the design of the study, we were inherently examining the most compliant patients since they were the ones that showed up to at least one retention check appointment. In doing so, a bias existed for patients that were, by default, compliant to some baseline level.

Previous studies have found that concern over patient compliance and appointment failures plays a significant role in the decision for practitioners to abstain from the state Medicaid programs. In this study, it was found that Medicaid and non-Medicaid patients have rates of PAR score improvement during treatment and worsening during retention that do not differ statistically. Despite missing more appointments, Medicaid patients were not hindered in the improvement of their malocclusions during orthodontic therapy. Similarly, contrary to the perceived notion that Medicaid patients do not comply with instructions as well as non-Medicaid patients, they did not show an increase in the rate of relapse after active orthodontic therapy had concluded. This data provides a promising outlook for orthodontists who would like to treat Medicaid patients but are discouraged by the belief that the treatment of these patients is not as

rewarding for the practitioner. One of the major deterrents of practitioners treating Medicaid patients could be based on false perceptions.

A recent study from the University of North Carolina compared Medicaid and non-Medicaid orthodontic treatment outcomes.[32] In that study, cases were matched by severity, so initial PAR scores were expectedly similar. However, final PAR scores were not found to differ between the two groups, which is in concordance with the present study. That study did not find any differences in broken appointments, broken appliances, or oral hygiene between the two groups. Those patients were all private practice patients whereas the study at Virginia Commonwealth University evidenced a difference in broken appointments in a university setting.[21] Patients that present greater challenges to treatment, whether due to management or actual case difficulty, are sometimes referred to universities which may create a difference in the populations studied in the VCU study and the UNC study.

Mirabelli et al.[15] studied reductions in PAR scores in phase 1 treatment of a Medicaid population and found that despite a greater lack of compliance with Medicaid patients, their end of treatment PAR scores were comparable to non-Medicaid patients. The results of this study are in agreement with the outcomes reported in Mirabelli et al.'s study.

Another study investigating the orthodontic outcomes of indigent populations was performed in Canada.[33] First Nations orthodontic patients were compared to non-First Nations patients. It was found that the First Nations patients had greater initial PAR scores, but that final PAR scores were similar between the two groups. This comparison of First Nations patients is in agreement with the results of the present study of Medicaid patients.

One of the limitations of this study was an innate weakness of the PAR index to reflect the finer orthodontic nuances of a patient's malocclusion. For example, a patient with several half-millimeter spaces between the lower incisors could have a PAR score of 0, as the sensitivity of the PAR index is not great enough to distinguish this particular scenario from a truly ideal occlusion. Another limitation of this study was that the improvement of PAR scores was assumed to be linear throughout treatment and during retention. Teeth do move linearly to some extent when not in equilibrium, but the PAR score measures more than the simple spatial displacement of teeth. If the PAR score was continuously measured during orthodontic treatment, it is possible that a large reduction in PAR score would be seen relatively early in treatment as crowding is resolved, but minimal PAR improvement would be seen during the later stages of treatment as orthodontic detailing is completed.

One of the difficulties in completing this study was that an inherent bias existed in the method of sample selection: patients that never attended retainer check appointments were not accounted for. Although it is possible for a patient to never return for any retainer adjustments, it is highly unlikely. This study evaluated only patients who attended at least one retainer check appointment. In an average orthodontic practice, it is conceivable that most patients would fall into this category.

Further research can be done into the temporal behavior of the PAR score throughout orthodontic treatment. Repeated PAR score measurements could be performed over the course of orthodontic treatment to determine a model to represent PAR score changes during treatment. To address the shortcomings of the PAR index, this study could be re-examined with use of the ABO OGS instead of the PAR index.

Conclusion

The conclusions of this study were:

1. The mean pre-treatment PAR score was significantly greater in the Medicaid group.
2. The mean end of treatment PAR score did not differ between the two groups.
3. The mean rate of PAR score improvement during treatment did not differ between the two groups.
4. The mean rate of PAR score worsening after the removal of orthodontic appliances did not differ between the two groups.

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Vita

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